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A NOVEL AND EFFECTIVE LIGHTING INSTALLATION

DIESEL ENGINE PRACTICE
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AVAILABLE POWER FOR COLUMBIA RIVER PROJECT
BY L. F. HARZA.

STEAM CONDENSERS AND CONDENSER TUBES
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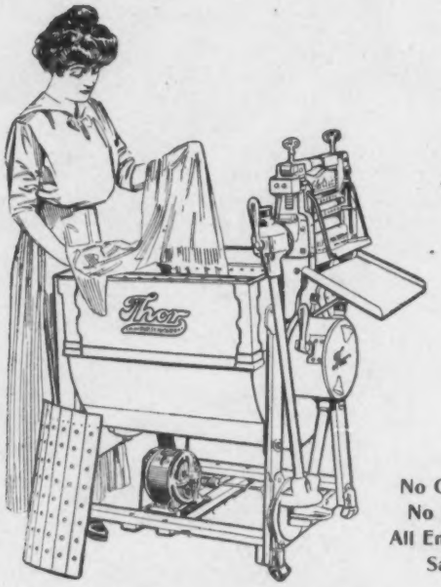

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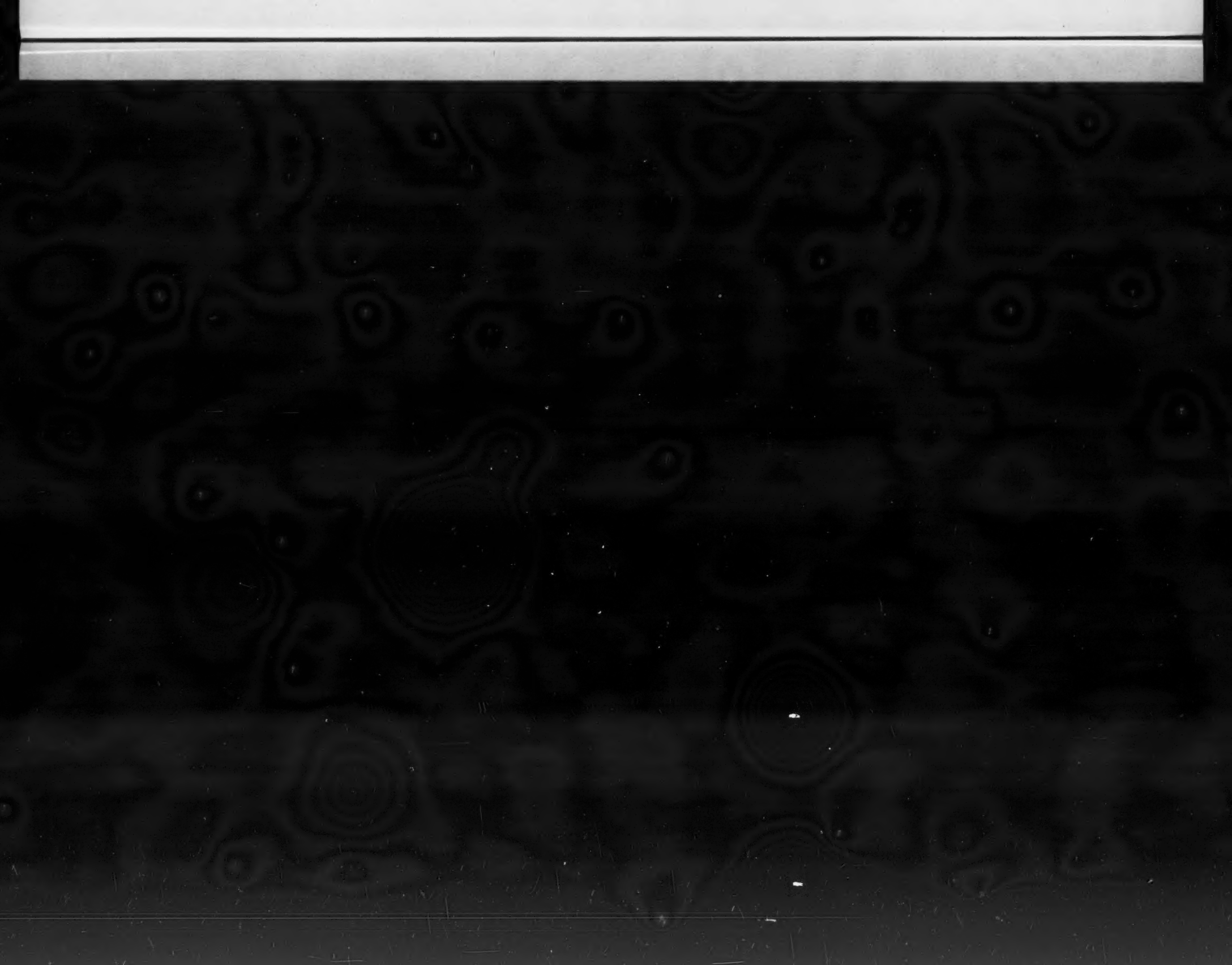

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A NOVEL AND EFFECTIVE LIGHTING INSTALLATION

One of the handsomest and most unique candy and catering establishments in Los Angeles is the new store of L. J. Christopher, situated on Broadway, between Seventh and Eighth streets. Mr. Christopher placed no restrictions on the architect, decorator and illuminating engineer and co-operatively they have created a work of art, without the sacrifice of utility.

The lighting, with which this article is to deal, required, in view of the architectural and decorative conditions, considerable study and special treatment.

Unique Lighting of Christopher's Banquet Hall.

The forward half of the store proper receives softly diffused general illumination by means of mirror lined trough reflectors, located in coves, constituting a cove system of illumination, devoid of glare. The show and counter cases are lighted by specially designed reflectors, equipped with 15 watt, T 8 candelabra lamps. The heat factor is so inconsiderable that the candies and chocolates are not affected. The combination of cove and case lighting makes an ideal condition for the attractive display of case goods, the soft general illumination being ample, yet allowing the case contents to be emphasized with low candle power lamps.

The rear half of the store presented a difficult condition. The sidewalls are hung with dark blue silk brocade, very susceptible to surface distortion in a strong light. The desired method of illumination required pedestals, surmounted by shallow bowls, 21 by 4½ in., supported 7 ft. 6 in. from the floor and 4 ft. 2 in. from the side walls. There are eight units on each side, or sixteen in all. Each bowl is equipped with one 250 watt type C stereopticon lamp, which direct rays of the lamp from the side walls, reflecting made of opal cathedral glass. This reflector cuts the direct rays of the lamp from the side walls, reflecting the light upward and toward the center of the room. They serve also as screens, allowing only enough light to penetrate to produce a soft, even glow in and over the large bowls. The effect obtained is that of a cove system so even is the illumination and so devoid of glare. Photometric tests show an average intensity of 2 f.c. at a wattage cost of about 1.7 w.p.s.f. The large banquet room on the second floor is equipped with a most unique system of illumination. It is claimed that this is the only room illuminated by means of projectors. There are 16 of these, 8 on each side of the room, located as shown in the illustration. Each projector is of spun brass, heavily plated, 18 in. in diameter and equipped with a 250 watt, type C stereopticon lamp. As the cut shows, the ceiling is divided into four panels, in the center of each being

a compo-plaque of conventional sun-burst design, 5 ft. by 7 ft., overlaid with aluminum foil, stained in different colors. There is a curve to each plaque, so designed that when a pencil of light from the projector strikes its surface it is deflected and diffused at the proper angle. The inside of each reflector holder is

Cove Lighting of Front Part of Store.

painted in stripes of vivid red, green and blue and these colors in turn are reflected to the upper edge of each projector which has the appearance of a huge irridescent bubble about to drop from the container. Due to the characteristics of the parabola, there is absolutely no glare, and the beams of light are invisible, except when the diners are smoking. Contrary to expectations, these beams then add interest to the room, rather than prove objectionable. The entire

Pedestal Lighting of Rear of Store.

scheme is unusual and daring and the general effect extremely beautiful and unique.

The average intensity on the floor, which measures 85 ft. by 30 ft. and is 13 ft. 6 in. from the ceiling, is 1.6 f.c. and the wattage is about 1.2 per sq. ft.

This installation deserves special mention, not alone on account of its beauty, but because it marks a decided step forward in the art of interior illumination. Due credit should be given to L. C. Norton, a local illuminating engineer, who is making a splendid record for himself in Los Angeles, and Arthur Hememan, the architect of the establishment.

THE LEWISTON-WAHA POWER SYPHON.

BY OTTO B. GOLDMAN.

Lewiston, Idaho, is situated at the junction of the Snake and Clearwater Rivers. Its elevation above sea-level is 650 ft. The hills southeast from Lewiston rise abruptly to about 1200 ft. elevation, then gradually rise until a distance of twenty miles is reached and then another abrupt rise is made into the mountain range. These hills are barren and dry, but the soil is fertile and deep. As the hills are rolling they have an excellent cold air drainage.

The bringing of water to so large a tract of land has been the problem of over half a century.

Twenty-five miles southeast of Lewiston is a chain of three lakes. The lakes are situated one above the other, the highest one, Lake Waha, lying at an elevation of about 3100 ft. and has an area of about one square mile, with a maximum depth of 90 ft. The two lower ones are, however, comparatively small.

Lake Waha was formed by the fill between two projecting spurs of the mountains. This fill is not impervious to water, and the leakage through it forms the lower lakes.

The lower lake was also fed by a spring of about three second feet. This spring is quite a distance above the lake, so that it was possible to flume this water above the lower lake bank into the canyon beyond.

This was done a number of years ago by the Lewiston Sweetwater Irrigating Company, the water being carried some 15 miles to a large reservoir, and thence distributed. The quality of the water being excellent it was also used for domestic purposes.

The water from the reservoir is entirely distributed by pipes. The entire tract of the Lewiston Sweetwater Irrigating Company consists of about 8000 acres, of which 6000 acres are now in orchards. On account of this large development a much larger supply of water was imperative. This naturally focused attention on how to get the water out of Lake Waha.

This was an old problem; the first attempt to take the water out of the lake having been made as far back as 1863. Since that time an immense amount of money has been lost in attempting to utilize this water. It must be noted that the fill or lower bank of Lake Waha is 115 ft. above the mean water level, with a base of nearly a mile through, so that tunneling would be a matter of immense cost.

The idea was finally conceived by H. L. Powers, manager of the irrigating company, that the water could be pumped over the fill, then dropped in a penstock sufficiently to develop enough power to operate the pump, thus creating what may be called a power syphon. The idea is not new, having been suggested on other propositions. But the writer knows of no installation of this type actually made.

The irrigating company acquired the water rights of Lake Waha and engaged the writer to design the system. The following data was available: The capacity desired to be pumped was 10 second feet, with a static head of 115 ft. normal and 125 ft. maximum, the total drop of 600 ft. being available. To meet these conditions, a Pelton water wheel was installed direct connected to a 250 k.v.a. General Electric

three-phase, 60-cycle, 2200-volt generator operating at 600 r.p.m., with a seven kw. belted exciter.

The switchboard, besides having the necessary rheostats for voltage control, voltmeter and ammeter, was also equipped with contact making ammeter for underload alarm.

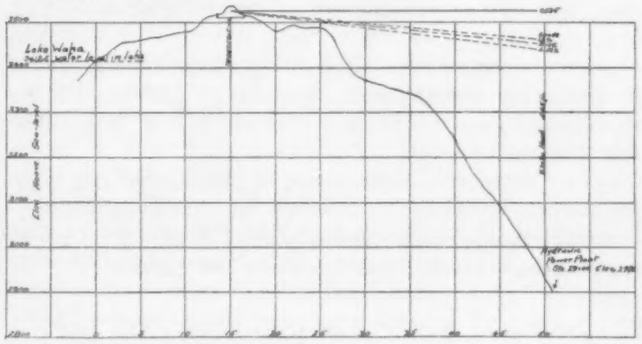


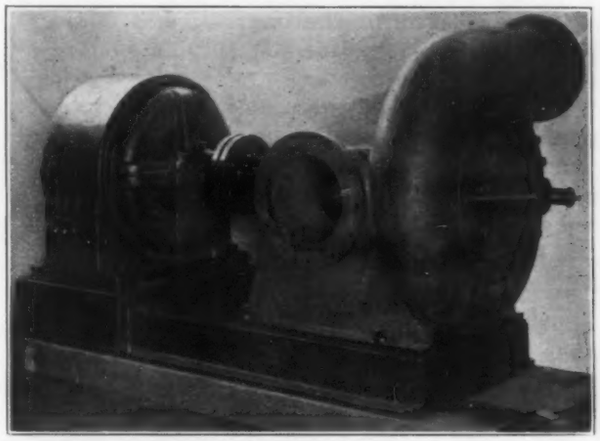
Fig. 1. Profile of Pipe Line.

A transmission line was then run to the pump house at the lake, consisting of three No. 3 B. & S. copper wires. These run through an automatic control board to a 250 h.p., 1200 r.p.m. General Electric slip ring induction motor direct connected to a 12 in. single stage Goldman pump. Both the suction and discharge pipe of this pump was 20 in. in diameter. The total length of this riser pipe is about 1800 ft. This empties into a small reservoir of about 3000 cu. ft. capacity. This connects with the penstock, which was installed 16 in. outside diameter. The profile of the entire pipe line is shown in Fig. 1. In order to start the system, it was necessary to fill the entire pipe line and reservoir, and for this purpose there was installed a 35 h.p. Atlas gas engine belted to a 4 in. Class H, single stage Goldman pump. For priming, both this auxiliary pump and the main pump, there was provided a 5x5 double acting plunger pump instead of a vacuum pump as is usually done, to avoid water hammer.

The operation of the system consisted in utilizing the power developed by the water in the reservoir to start the water wheel and generator. The closing of the main switch at the power house caused the automatic control to start the main pump as rapidly as possible with not over 150 per cent of normal full load current. This was necessary to avoid serious overload, which would slow down the entire system, lowering the power factor and efficiencies, to the point where starting would be questionable if not impossible, especially on account of the limited storage capacity. The efficiencies of the various elements in this system are as follows. Water wheel, 78 per cent; generator, 90 per cent; line 92 per cent; motor 90 per cent, and pump, 73 per cent. From the power available at the generator must be deducted the power necessary to drive the exciter. To this may be added riser pipe efficiency of 95 per cent observed, and penstock efficiency of 90 per cent. The combined efficiency water wheel to and including pump is slightly over 40 per cent, and including pipe losses reduces it to about 34½ per cent.

While this appears to be a low efficiency for a plant of this character, it still presents quite a different aspect when considered on the basis of first cost, and proves itself to be a financial success. Because the tunnel, as pointed out previously, which would have had to be constructed through the fill at Lake Waha would have cost between 30 and 40 times as much.

There are, no doubt, many other propositions, which are feasible with an installation of this type. Care should be taken to see that there is ample drop to allow for the low overall efficiency.



Motor Driven Pump.

In this instance also, the cost of constructing a reservoir was so large that as small a reservoir as was considered safe was used. Under actual test 1000 cu. ft. of water and 1½ minutes of time was all that was necessary to get into full operation. The object in making the riser pipe 20 in. in diameter with only 16 in. outside diameter drop pipe, is evident, from consideration of the overall efficiency. For every additional horsepower lost in pipe friction in raising the water, nearly three water horsepower on the power or drop side must be provided. Consequently the ratio of friction loss in the riser to that in the drop pipe should be approximately in the same ratio, i.e. three to one. In this instance where the power developed was more than ample, the surplus water was allowed to go through a by-pass at the power house.

In consultation the writer had the invaluable suggestions and criticisms of Mr. Hopson, engineer of the U. S. Reclamation Service, Mr. Grelle, M. E. of the Independent Foundry Company, Portland, Oregon, and Mr. Foster of the Lewiston-Clarkston Improvement Company.

Several interesting problems had to be solved. For example, there was considerable temptation to install a squirrel cage instead of a slip ring motor on the pump, and in starting, instead of bringing the generator up to speed first, and then starting the pump, the idea was to bring both generator and pump up to speed together. This was rejected because of the known low power factor, low efficiency and otherwise general lack of definite knowledge as to generator and motor characteristics under these conditions, so that it was questionable whether the system would start promptly, if at all. That our rejection was apparently correct was shown to us in a rather amusing trouble experienced.

When the first attempt to operate the system was made, it operated well the first few minutes, then showed a large increase in amperage with a large reduction in water pumped, so that in a few minutes more the system died down ingloriously. After start-

ing the system, the load on the pump motor was held at about 57 amperes, or full load, by holding constant speed and opening the discharge gate on the pump until this load was obtained.

Observations then showed that with the by-pass closed at the power house so that all the water pumped had to pass through the water wheel or else accumulate in the reservoir. The reservoir was raised rapidly as there was a considerable surplus pumped over that used for power.

The system would then continue to operate for a maximum of three minutes, then there occurred a rapid increase in current up to 100 amperes, and accompanied by a reduction in voltage. Also a reduction of speed generally took place. The discharge gate on the

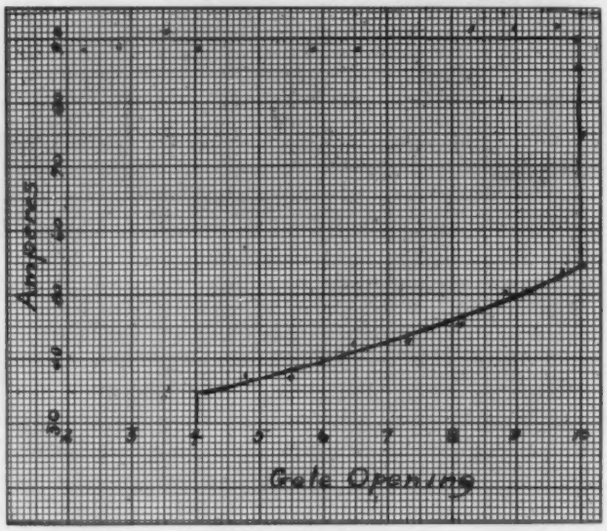


Fig. 2. Typical Test Curve of Mysterious Trouble Due to Belt Slippage.

pump was closed rapidly, but no appreciable reduction in current was observed. Sometimes, when the gate was being closed there would be a reduction in current with an increase in speed.

A typical test curve of this action is shown in Fig. 2. In as much as the water in the reservoir was limited, operation under these circumstances was limited to a maximum duration of 8 minutes. In this short time there was no opportunity for either the electrical or mechanical parts of the system to show excessive heating, so trouble could have been located. After numerous attempts to operate successfully, with the same results, electrical experts were engaged to find the trouble. After a month of investigation they reported the system as far as the electrical equipment was concerned, to be in perfect condition. Their report stated that the trouble must be due to excessive friction in the pump. The voltage drop being due to saturation of the generator due to overload and erratic readings obtained, were due to the short duration of the test periods. Therefore, to prove that trouble did not originate in the pump, the writer was forced to test the system again. Apparently some three hundred horsepower was mysteriously disappearing. The last test was carried on, with the assistance of Mr. C. E. Grelle. We worked on the supposition that the proper speeds had never been obtained. The test was started with reduced speed, so that the current was a great deal less than 57. The water rose readily in the reservoir. Suddenly the current rose to 86 and the water began to drop in the reservoir, the voltage became very erratic. Upon an inspection of the exciter we found that this was due to the exciter belt slipping. The belt was treated with dressing and changed, causing the current not to increase as it had done previously.

The trouble with this plant extended over a period of about six weeks, and cost nearly $3000, with an attendant loss of twice that amount, all because a $10 belt slipped.

The system is now operating perfectly, and with the successful carrying through of this type of construction, many more similar plants of this type could be used, where conditions for them are proper.

ELECTRICAL SUPPLIES INDUSTRY OF JAPAN

The electrical supplies industry in Japan has grown to a remarkable extent in the 25 years of its existence, and the country is no longer dependent upon foreign countries to supply its needs. Efficient moderate size motors and generators up to 100 h.p. are manufactured at moderate prices. The small sizes of motors up to 10 h.p. are made in large quantities, and comparatively cheap, and the export prices would compare favorably with those of European factories. Transformers are turned out at low prices and of good efficiency, but the iron sheets are in nearly all instances imported.

With the exception of submarine telegraph cable the former large import of insulated conductors has entirely ceased. All classes of electric lighting and power cables, rubber and paper insulated for high or low tension, are made to any specification; flexible silk cords, all types of telephone cable, military and naval cables, are well made in large quantities in well laid-out factories and under expert and scientific supervision. Porcelain insulators and porcelain ware and glassware for all purposes are largely exported. Brass work, switches, lamp holders, and cutouts, although perhaps not quite as good as the best European fashion, are at low prices and good.

Metallic filament lamps are made in large quantities, but practically all the producing factories are controlled by a monopoly which controls the export trade.

Switchboard instruments and meters are still imported where high-class work is required, but for ordinary use the Japanese-made article meets the requirements at half the price of the imported goods. The same may be said about laboratory and testing instruments and telegraph instruments, the native-made articles improving all the time and the imported goods being gradually superseded.

In telephones Japan is not only self-supporting, but is doing a considerable export trade to its near neighbors.

All the various electrical accessories are now being manufactured by small Japanese factories. Electric fans, torches, bells, batteries, devices of every kind as used in Europe and America are obtainable at prices often lower than they can be produced in western countries.—[Summary of an article appearing in "Commercial Japan," Nov., 1915, transmitted by Consul General George H. Scidmore, Yokohama.]

REPORT ON THE COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix E—Available Power.

(Concluded.)

Secondary power. In addition to the 480,000 horsepower of what is variously known as "base," "primary" or "perennial" power, available continuously throughout the year, there would also be a large range of heads between maximum and minimum when there would be a surplus of water, head and generating machinery. The surplus water could be used at such times, up to the capacity limit of the machinery, without any additional cost whatever except depreciation of machinery, oil, etc. The power thus furnished is known variously as "surplus," "secondary" or "seasonal" power.

In Fig. 23 three turbine curves are shown, one applying to the total output capacity of the high head units, one to the total capacity of the low head units, and the third to the combined capacity. A line is also shown representing the normal generator rating of 805,000 kw. or 1,080,000 horsepower. The station generating capacity at any given flow is now represented by the minimum of the three curves representing: (1) the power of the river, (2) the generator rating, and (3) the total power of the turbines. This line it shaded for prominence. The line of 480,000 horsepower or the primary capacity is also shaded. The secondary power is represented by the difference in height between these two curves.

The amount of this surplus power which would be of commercial value depends largely upon the number of days per annum during which it could be delivered with reasonable certainty. Fig. 26 shows an average annual duration curve of the river discharge for the entire thirty-six years and another one applying to the last twenty years. There are also shown two curves of corresponding power capacity taken from the upper shaded line in Fig. 23.

The average number of days and months per year during which certain specified amounts of power could have been delivered, as taken from this curve, are shown in the following table:

Delivery in h.p.	Amount of Surplus Above Primary Capacity.	Duration Based Upon 20 Years' Record. Days.	Months.	Duration Based Upon 36 Years' Record. Days.	Months.
1,080,000	600,000	132	4.34	115	3.78
900,000	420,000	221	7.26	206	6.77
800,000	320,000	270	8.87	262	8.62
700,000	220,000	324	10.66	314	10.33
600,000	120,000	353	11.61	342	11.24

The salability of surplus power depends also largely upon the regularity with which it can be depended upon. Thus, an average duration of eight months per year with a range of from seven to nine months would be more desirable than with a range of from five to eleven months. It also depends upon whether the surplus power results from any freshets of short duration with intermediate deficiencies or in one continuous period.

In these respects the conditions offered by this power site are very favorable. The power would be available in two seasons, each usually continuous for several months. One starts in with the rising stage following the cold season of January or February and continuing until the June flood, the other lasting from the subsidence of this flood to the approach of the cold season again.

Fig. 27 shows by the light line a hydrograph of the year 1887-1888, and by the heavy line the corresponding power curve. These curves are typical as to general shape, but represent a year of both unusually high water and unusually low water. The flood season here shown (1887) was shown in the duration curve Fig. 25, as one of the four extreme floods, and the low season (1888) in Fig. 24 as one of the low periods. The low water fell to 49,400 sec. ft. for one day. The two seasons without surplus power, one for the low water and one for the high water, are plainly evident.

In Fig. 28 are diagrams showing the number of months and days per annum during existing records when power to the amount of 600,000, 700,000 and 800,000 horsepower could have been generated. From these curves it is concluded that the variations of individual years from the mean duration shown in Fig. 26 and in the above table are too large to warrant the adoption of the mean duration. For this reason the following durations have been chosen from this diagram as sufficiently dependable to indicate a commercial value for the power:

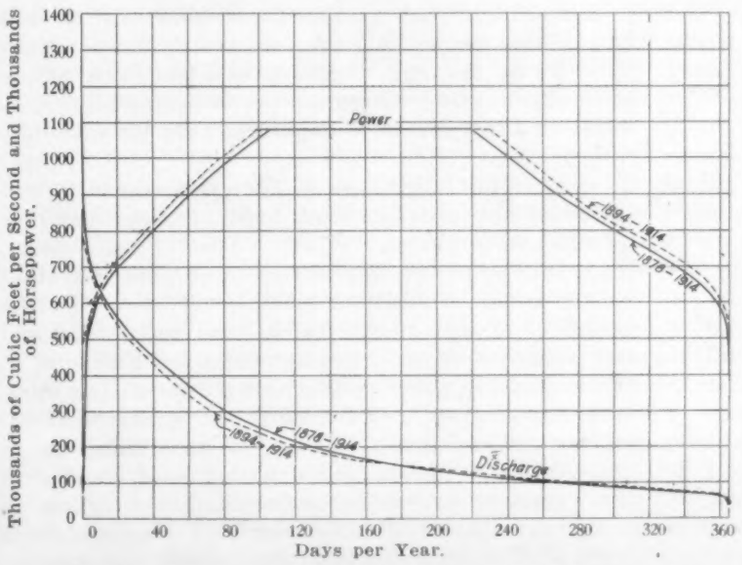


Fig. 26. Mean Annual Duration Curves of Discharge and Corresponding Power.

Total Delivery in h.p.	Amount of Surplus Above Primary Power.	Months Available Per Annum.
800,000	320,000	8
700,000	220,000	10
600,000	120,000	11

Relation of secondary power to turbine erosion. The use of this secondary power is dependent upon the feasibility of operating the low head units throughout nearly the entire range of heads. The Holyoke test of the low head runner under consideration, after deducting 3 per cent throughout, indicates the following efficiencies:

45 feet head.....81 per cent
63 feet head.....86 per cent
100 feet head.....80 per cent

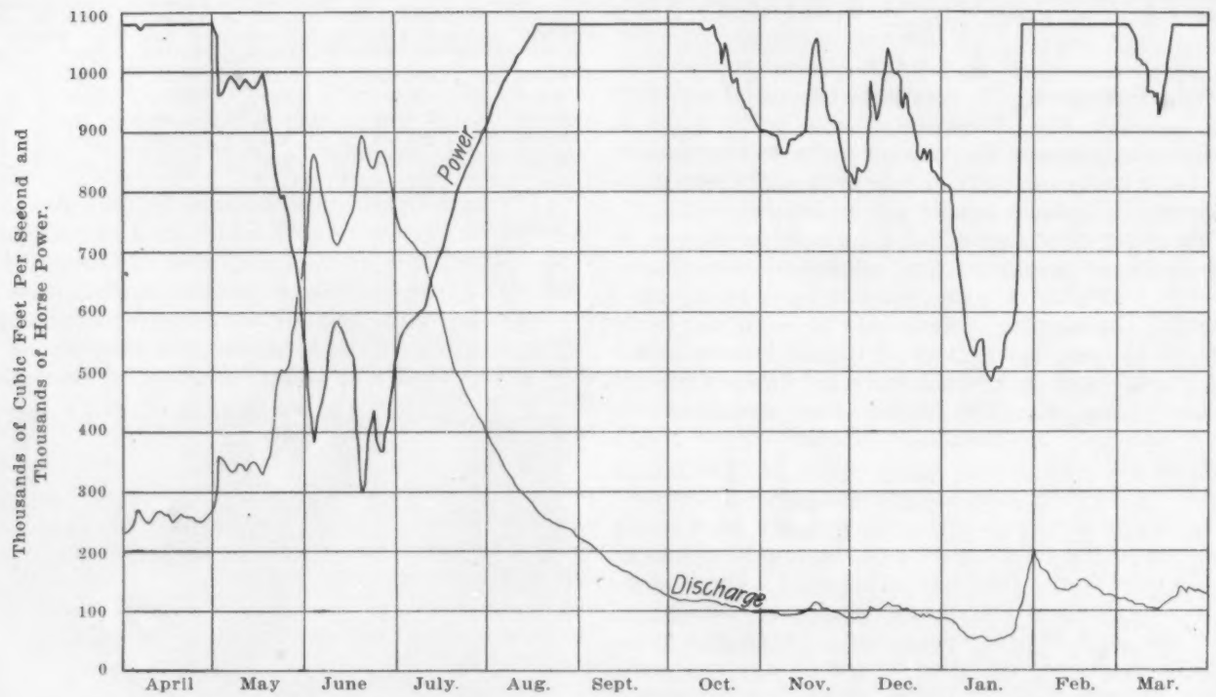


Fig. 27. Typical Hydrograph and Corresponding Power Capacity of Proposed Station.

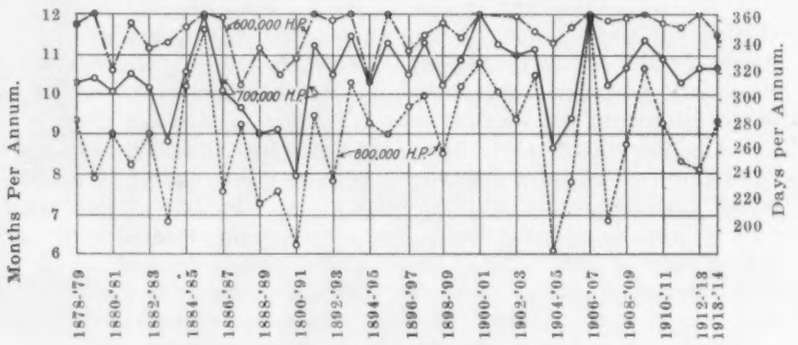


Fig. 28. Annual Duration of Generating Capacities of 600,000, 700,000 and 800,000 Horsepower.

These results are believed to be sufficiently high to furnish some assurance against severe erosion, and it may be expected that still better results will have been accomplished before turbines for this installation are to be purchased. Runners of this type have, however, never been used for heads above 75 ft., and their operation without excessive erosion is not certain. The estimated cost will be based upon the use of cast steel runners as additional insurance against depreciation from this source, and the annual depreciation will include a fund for renewal every three years of one-half of all the runners of the low head units. Only one-half of the low head units would be needed for heads above their proven range to maintain the entire surplus power. With this provision it is believed that the surplus power could be depended upon and that the additional depreciation resulting from its use would be justifiable from the standpoint of the additional income.

Power for irrigation. Fig. 6 is a hydrograph representing the diversion of water from the Yakima River in the years 1912 and 1913 for the Sunnyside project, U. S. Reclamation Service. It is probably typical of projects in this region except during the early part of June in 1912, and all of June, 1913, when the curve is apparently lower than normal, probably due to rainfall. It will be seen that June, one of the months of maximum demand, coincides with the maximum flood month of the river and is therefore a period of little or no surplus power, depending upon the magnitude of the flood peak. This can best be studied by reference to Fig. 4 and Fig. 26. Judging from the last twenty years there would have been available during June in all except five years, the difference between the station capacity at 700,000 second feet and that at 800,000 second feet, for which latter the machinery was chosen. This amounts to about 85,000 h.p. The possibility of the recurrence of another period of high years such as those from 1858 to 1894 would seem to preclude the possibility of dependence upon floods less than 800,000 second feet for a supply of surplus power for irrgation purposes, for which certainty of supply is more important than for manufacturing.

Power for irrigation must for this reason be obtained by the installation of additional machinery or by the use of primary power. This is unfortunate, since surplus power, if available during the irrigation season, could be sold at a much lower price. By the use of additional machinery, in case space for canal and power house could be obtained, a large amount of power could be generated for this purpose. The minimum flow during April for thirty-six years was 87,400 second feet, on April 5, 1880. The usual minimum is much higher. The minimum flow toward the end of the irrigation season has occurred in September on three occasions: 1889, 1903 and 1905, the discharges being 78,000, 130,000 and 77,800 second feet respectively. Otherwise the minimum has occurred in Octo-

ber, usually near the end of the month. The following table shows the lowest flows for the first of, and for the entire irrigation season, with date of occurrence:

Table of Minimum Discharges During the Irrigation Season.

Year.	Minimum Flow of Season.	Date of Occurrence.	Minimum of Entire Season.	Date of Occurrence.
1878	176,000	April 24	82,900	Oct. 31
1879	313,000	" 1	91,000	" 31
1880	87,400	" 5	87,400	April 5
1881	278,000	" 1	99,100	Oct. 25
1882	192,000	" 1	102,000	" 28
1883	167,000	" 26	79,000	" 27
1884	117,000	" 1	112,000	" 7
1885	215,000	" 1	95,400	" 30
1886	128,000	" 2	76,000	" 31
1887	235,000	" 1	99,300	" 31
1888	129,000	" 1	89,200	" 23
1889	110,000	" 1	78,000	Sept. 27
1890	145,000	" 1	83,400	Oct. 24
1891	88,000	" 7	80,100	" 26
1892	128,000	" 8	96,000	" 31
1893	130,000	" 1	108,000	" 29
1894	266,000	" 8	125,000	" 21
1895	143,000	" 1	84,500	" 31
1896	152,000	" 7	78,000	" 31
1897	130,000	" 1	85,600	" 31
1898	111,000	" 1	85,600	" 30
1899	120,000	" 3	120,000	April 3
1900	216,000	" 1	99,000	Oct. 19
1901	137,000	" 6	77,000	" 31
1902	88,300	" 3	76,200	" 31
1903	160,000	" 18	130,000	Sept. 23
1904	164,000	" 1	75,400	Oct. 31
1905	114,000	" 10	77,800	Sept. 25
1906	165,000	" 1	85,600	Oct. 15
1907	156,000	" 2	96,000	" 31
1908	110,000	" 11	83,800	" 27
1909	132,000	" 1	91,000	" 31
1910	249,000	" 8	81,100	" 1
1911	134,000	" 20	75,400	" 31
1912	113,000	" 1	85,600	" 31
1913	155,000	" 1	102,000	" 31
1914	134,000	" 4		

From the showing in this table it is believed that a flow of 90,000 second feet or even more could be depended upon with reasonable assurance at the beginning and 80,000 at the end of the irrigation season, corresponding respectively to 830,000 and 750,000 h.p., or 350,000 and 270,000 h.p. in excess of the primary load of 480,000.

As shown in Fig. 6, the demand at the close of the season in 1912 was 50 per cent of the peak demand and in 1913 about 40 per cent. Moreover about 50 per cent of this closing demand in each case is represented by seepage and waste which would probably be eliminated as a matter of economy to a larger extent in a project irrigated by pumping, thus reducing this ratio of October demand to peak demand. The flow of the river, as shown by the hydrographs, is usually dropping through August, September and October, as is also the irrigation demand. No detailed study of their relative drop has been made, but from general inspection of the hydrographs and from the above figures it would seem that power could be developed for irrigation purposes without encroaching upon the primary capacity of the station, to the extent of about 250,000 h.p. at the close of the season, corresponding to at least 500,000 h.p. of June and July demand and requiring the installation of extra machinery of the latter capacity for its generation. The problem of space for canal and power station for this extra equipment is a very difficult and expensive one as will be discussed later.

Relation of irrigation load to secondary power load. It must be remembered that the use of surplus water above 50,000 second feet was contemplated for the generation of secondary power and that any development for irrigation would be in lieu of the former use or would at least so shorten the annual period of available secondary power that its commercial value would be doubtful. Moreover, it would require additional power house and equipment, whereas the former use would not.

Secondary power as auxiliary for existing electric service corporations. It so happens that nearly if not quite all of the small rivers in this territory which have been developed for power, experience their minimum flows during the months of August, September and early October, during which period surplus power in large amount would always be available at the power site under consideration. The use of any of this surplus power as auxiliary by the existing public service companies would affect only the fall period of surplus, but the spring surplus season would probably then be too short for the power to be of any commercial value. This prospective use as auxiliary is therefor in lieu of the use of an equivalent capacity for either irrigation or secondary manufacturing load.

A low and sustained minimum flow period is characteristic of most of the many smaller developed and undeveloped power streams in this generally mountainous region. This dry season is moreover coincident with the large demands made upon the ground water by the season of plant growth, and the resulting minimum is a serious obstacle to economical power development. Cheap surplus power from The Dalles should prove of great ultimate value to all other power development within its range of influence by thus increasing the economical generating capacities of existing and future stations on the smaller rivers.

Tramp life de luxe has been discovered near Marysville, California, in a "jungle" where a hobo has a home-made electric cooker, the "juice" for which he gets by hooking a wire to a third rail.

The cable bug is a small insect (sinoxylon declive) which, for purposes of concealment, bores small holes in the lead coverings of telephone and other cables. This insect ordinarily attacks wood but its damage to the lines of the Home Telephone & Telegraph Company of Santa Barbara, California, amounts to between $300 and $500 a month. The bugs are hard to find as they fly away. No effective means has yet been found of preventing their ravages.

A lightning flash may have a maximum current of more than 20,000 amperes, a frequency of from one hundred thousand to five hundred thousand cycles and a potential of at least half a million volts. No system of protection for oil tanks has been accepted by oil companies as giving protection commensurate with the cost. Lightning rods reduce the fire hazard by 80 to 99 per cent in the case of houses and by as much as 99 per cent in the case of barns.

Refillable fuses are not approved for general use by the Underwriters' Laboratory but as a result of an investigation by the U. S. Bureau of Standards the use of Economy fuses is "permitted by municipal and underwriters' inspection departments under conditions where their performance can be observed by each inspection department until sufficient experience regarding their performance under service conditions can be obtained to justify an unqualified approval or refusal to approve."

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Modern Engines.

In present day design, Diesel engines are divided into two classes, the vertical and horizontal. Each of these types has their advocates. In Europe there has been a general adherence to vertical engines and at present the greater number of American builders are following lead. In the vertical engine some manufacturers are using the open "A" frame construction while others have adopted the closed box-frame crank case. The advantages of these types, as claimed by the manufacturers, are accessibility of the "A" frame and cheapness of construction as against the more expensive and more rigid construction of the box type crank case. The matter of cleanliness and absence of vapors being blown from the crank case is also an argument advanced by the latter. Steam engineers in general are advocates of the "A" frame construction, and this type has been operated in America with entire success. On the other hand the operation of the enclosed crank case has also many advocates and has been proven by long experience. It has been adopted by the largest European builders and is preferred there, particularly for high speed engines. This type of construction, however, cannot be carried into extremely large sizes as the capacity of freight cars is limited, both as to the size and the weight of the casting which can be transported. It is usual with builders of "A" frame engines to enclose the working parts with some type of guards of sheet steel with small removable doors for observation.

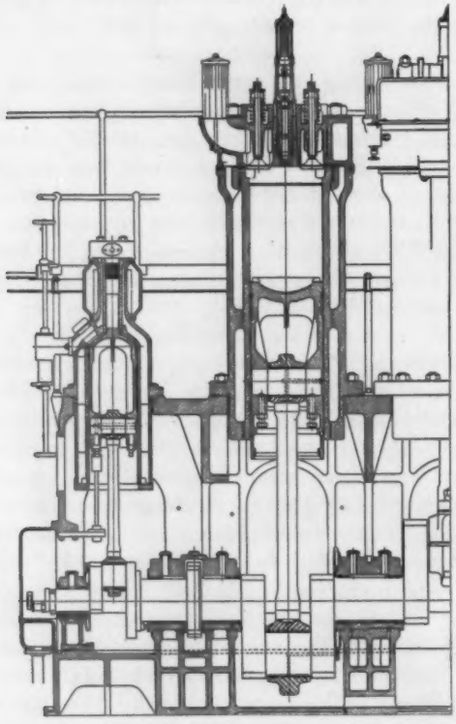


Fig. 11. Section of McIntosh & Seymour Oil Engine.

The McIntosh & Seymour engine is designed with "A" frame as shown in section in Fig. 11. The main bearings are lubricated by chain oilers. The cylinders are lubricated at two different points, one in the front and one in the back, from a mechanically driven sight feed pump. The piston pin is provided with a separate lubricating pipe from the mechanical lubricator, which delivers its oil to a "V" shaped vertical groove in the piston; from this groove the oil is forced through a hole in the center of the wrist pin, whence it is lead to the bearings. The crank pins are lubricated by centrifugal oilers.

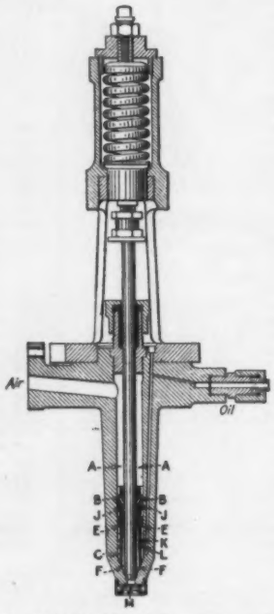


Fig. 12. McIntosh & Seymour Atomizer.

The atomizer is that invented by K. H. E. Hesselmann of the Aktiebolaget Diesels Motorer, (Swedish Diesel Engine Co.) shown in Fig. 12. Its essential feature is that instead of pulverizing the oil by crowding it down through perforated plates it draws it by the injector principle into the current of ingoing injection air, which atomizes and absorbs it as fast as it is drawn up. The charge of oil is deposited in a chamber, which it does not fill, even at an overload. Air is admitted to the chamber **A-A** and passes through the ports **B-B,** while it has also access to the oil chamber through the space **E-E.** When the fuel valve opens, the air, rushing through the port, passes through the expanding passage **F-F,** between the valve stem and the receding wall of the surrounding fitting, induces by injector action a difference of pressure which causes the oil to flow to the space, into which the oil, having been elevated and broken up through slotted plates **K** and **L** is drawn and picked up by the ingoing air. The form of the fuel plate has an important effect upon the efficiency of the atomizer.

The engine is started from a single cylinder. No attempt is made to relieve compression in starting as this is claimed to be unnecessary in engines below 500 h.p. Means are provided, however, for holding the exhaust valve open during the turning or barring of the engine by hand, preparatory to starting.

The cam shaft is located on the level of the heads, the cams not being housed. They are driven by a vertical shaft and screw gears. The rocket arms on these engines are practically alike, the rocker arm shaft being supported by steel pedestals fastened to the cylinder heads.

The variation of the quantity of oil pumped by

the fuel oil pump is accomplished by varying the stroke of the pump plunger eccentric operated off the vertical shaft.

The Lyons Atlas engine as built by the Lyons Atlas Engine Co. of Indianapolis, is unique, being truly of American design. It is not connected in anyway with any European concern. The engine is of the "A" frame type, designed by Mr. Norman McCarthy. It is of the vertical, single-acting, enclosed type, with automatic lubrication, ample protection being supplied to the working parts by sheet steel covers. The base contains the housings for the main shaft bearings and also forms a reservoir for lubricating oil. The "A" frame for each crank is cast in one piece with the cylinder. It fits on the base, completely covering the crank pit. The main bearings are in halves, split horizontally. Each bearing is fitted with two ring oilers, the reservoir box being filled with splash in the crank case. The main shaft is a solid forging of open hearth steel, the cranks being fitted with counter-weights to absorb vibration. The connecting rods have solid upper ends, the lower boxes are babbitted. The upper or wrist pin boxes are of phosphor bronze backed by a steel wedge. Adjustments can be conveniently made from the outside through side openings. The cylinder is provided with a liner cast separate from the cylinder proper. The heads are of close grained cast iron and are water jacketed, and can be removed without disturbing the valves. The pistons are of the long trunk type fitted with seven compression rings, no wiper ring being provided. A hardened steel wrist pin is ground to a perfect surface and firmly secured in the piston. The valves are in cages to permit of ready removal for regrinding. The splash system as well as the forced lubrication system is used by this company for lubrication.

The fuel injection pump is of the two-stage type, the first stage being directly controlled by the governor and serving to measure at the last instant before the beginning of each working stroke the exact quantity of oil that is to be admitted. This governing stage operates against pressure not in excess of atmosphere and is sufficiently sensitive in action to perform its important functions with the necessary quickness and accuracy.

The Lyons Atlas Company have built a 600 h.p. engine in four cylinders, this being the largest Diesel engine yet constructed in America. Two engines of this size were shipped to China and one of this size is in operation in the Hawaiian Islands. These engines have cylinders 21 in. by 30 in. stroke, developing 150 h. p. when operating at 164 r.p.m.

The Fulton-Tosi engine built by the Fulton Iron Works of St. Louis, is similar in most respects to the other A frame engines. The cam-shaft is on the front of the engine at the level of the cylinder heads. It is encased in a cast-iron housing for the full length of the shaft and the cams and gears operate in oil. The cam shaft is driven from a vertical shaft which also drives the governor and the fuel oil pump, bronze and steel spiral gears being provided.

The rocker arm slips off the end of the supporting rod without disturbing any other parts of the arm or head.

Variation in the quantity of oil delivered by the fuel oil pump is accomplished by maintaining a constant stroke of the pump plunger with a constant pump cylinder volume during the suction stroke and varying the pump cylinder volume during the delivery stroke. This is shown in Fig. 13. The method is in general use in America.

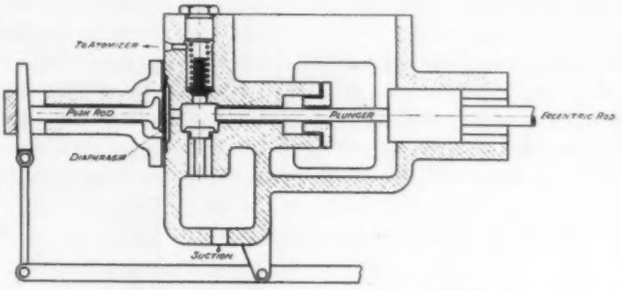


Fig. 13. Fulton Tosi Fuel Oil Pump.

Busch-Sulzer Bros. adhere strictly to the box type of construction up to 500 h.p. The engines (shown in section in Fig. 14) are of the box frame type with all parts under force feed lubrication—the cylinders, main bearings, cranks and wrist pins. The cylinders are lubricated at six different points by a sight feed mechanical lubricator. The main bearings, crank pins and wrist pins are lubricated with a positive displacement rotary pump located in the crank case and driven by gears from the main shaft. It takes its oil

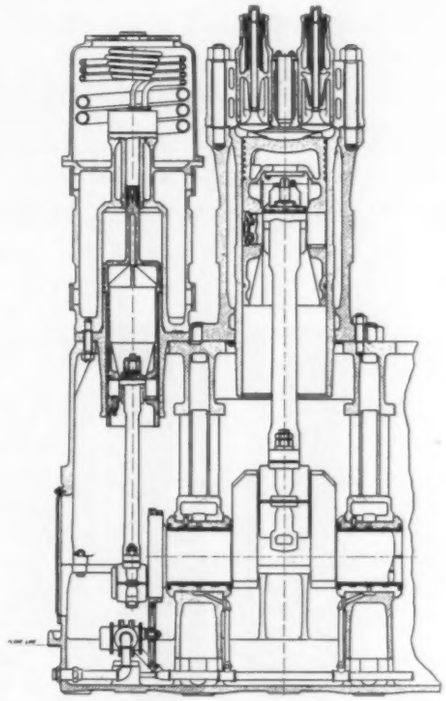


Fig. 14. Section of Busch-Sulzer Bros.-Diesel Engine.

from a filter and cooler below the floor line at the end of the engine. The crank shaft (see Fig. 15) and connecting rods are provided with a ⅜ in. hole extending from the main bearing through the web to the center of the crank, the same sized hole extending through the entire length of all connecting rods both for working cylinders and compressor. Fifteen pound pressure is maintained on the lubricating oil by the

rotary pump and a gauge in plain sight of the operator indicates the pressure.

The atomizer is that employed by Sulzer, and, in type at least, by most of the Diesel licensees, as shown in Fig. 16. The charge of oil for the coming stroke is delivered to the chamber, which is continuously in connection with the bottle containing the high-pressure injection air. At the bottom of this chamber are disks with perforations which do not register, so that when the fuel valve opens, the oil coming through one of the perforations of the top plate is driven against the solid portion of the next plate with a velocity induced by a difference of pressure of some 400 lb. at a maximum and it is broken

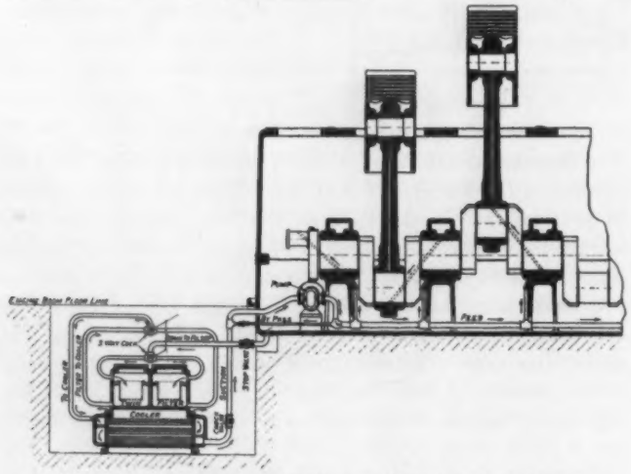


Fig. 15. Lubricating System of Busch-Sulzer Bros. Engine.

up into a spray, in which form it is swept through the successive places, becoming finally atomized. The truncated cone below these disks is grooved on its outer surface, and the oil-laden air passes through these grooves and is directed against the edges of the

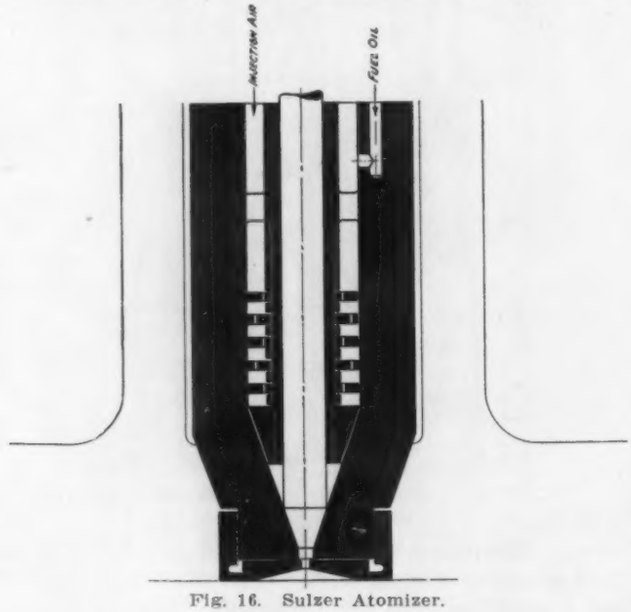


Fig. 16. Sulzer Atomizer.

opening in the nozzle plate in such a manner that its stream upon entry into the combustion chamber is spread into a saucer-shaper, umbrella like flame all over the surface of the piston. These engines are equipped with removable cylinder liners.

The engine is started from two center cylinders and is furnished with a mechanical device for simultaneously releasing compression on all cylinders by means of an additional cam which opens the exhaust valve on the compression stroke.

There are six compression rings and one wiper ring. This latter is a knife edge ring which is very efficient and effects a great saving in lubricating oil.

The cam shaft of the Busch-Sulzer engine is on the front of the engine at the level of the cylinder heads. It is encased in a cast iron housing the full length of the shaft and the cams and gears operate in oil. The cam shaft is driven from a vertical shaft which also drives the governor and fuel oil pump. Bronze

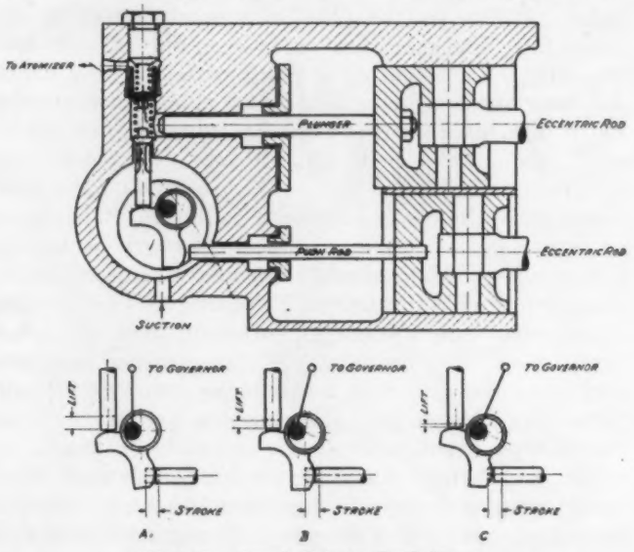


Fig. 17. Busch-Sulzer Fuel Pump.

and steel spiral gears are provided to drive the vertical shaft and the cam shaft. The rocker arm is in two parts and is claimed to permit of easy removal of the valve cages, particularly the exhaust valve.

The fuel pump is similar to that in general use in Europe and operates by what is known as the "by-pass" method. This by-passing is accomplished by holding open the suction valve of the pump during a portion of the delivery stroke. Both the plunger and the push rod have constant strokes but the action of the bell crank operated by the push rods is varied by its eccentric mounting, which is rotated under governor control; so that the suction valve of the pump is held open during the longer or shorter portion of the delivery stroke of the plunger. This is illustrated by Fig. 17.

Diagram "A" shows the parts in no load position, the suction valve being held open almost throughout the entire delivery stroke. "B" and "C" respectively show the parts in half and full load positions.

[To be continued.]

Substituting copper for aluminum conductors, because the present high price of aluminum made the exchange profitable, was recently undertaken by the power company supplying Rochester, N. Y. The change was made on the basis of aluminum at 56 cents and copper at 20 cents per pound, $84,000 being the profit from the sale of 63,000 lb. of aluminum in 2.2 miles of 428,000 circ. mil. duplicate three-phase line.

STEAM CONDENSERS AND CONDENSER TUBES.

BY A. F. C. WOOD.

(After the function of the condenser is simply explained, suggestions are given for minimizing corrosion of condenser tubes, including detailed directions for making photo-micrographs. The author is superintendent of generation for the Southern California Edison Company, from whose monthly magazine this article is taken.—The Editor.)

The steam condenser in a power plant is used, as its name implies, to condense the steam after it has gone through the engine or turbine. Two objects are secured by so doing, the pure water from the condensed steam is saved and can be used over again in the boilers, and more power is obtained from the same amount of steam, because not only does the high pressure steam push the turbine round, but the vacuum caused by condensing also pulls it round in the same direction.

As a matter of fact, a turbine delivers practically twice as much power condensing as when non-condensing with the same amount of steam, and furthermore returns all the steam as water, beautifully pure, that will not scale up the boilers.

Were it not for the condenser, a supply of fresh water for the boilers would be required at least fifteen times as great as that which we now use, and for the same load we would burn about twice the fuel oil, and this would not be all, for we would require twice as many boilers and turbines and buildings nearly twice as large.

Although it is not spectacular and has no revolving parts, and appears to be but a cast iron shell to casual inspection, realization of the above facts will lead to an appreciation of how important is this adjunct to the turbine.

The condenser on our 27,000 h.p. number three turbine at the Long Beach steam plant contains 7530 brass tubes, each 1 in. in diameter and 17 ft. 2 in. long, so that if placed end to end they would extend for twenty-five miles, and they weigh fifty tons.

Water is pumped directly from the ocean through all these tubes to keep them cold, and it is upon their 36,000 sq. ft. of surface that the steam coming from the turbine is condensed.

Every twenty-four hours 244,500 tons of sea water is pumped through this condenser, or enough to flood a city lot 50 ft. by 150 ft. to a depth of over one thousand feet; seven times the height of our tallest office buildings.

The tubes carrying all this water in the chamber are made of a brass of a special composition and are only one-sixteenth of an inch thick in the wall. Should they become damaged to the extent of leaking, the sea water will pour through the leak and contaminate the condensed steam, rendering it unsuitable for further use. For this reason every precaution is taken to reduce these leaks to a minimum by constant testing of the condensed steam, to see if salt has entered it; if so, the condenser is tested until the faulty tubes are found and either plugged temporarily or replaced by perfect ones.

Like most other things, tubes are afflicted with diseases; the best that can be hoped is that they will gradually waste away, dying of old age, when they become worn so thin that they can no longer hold together, but it may be that the violent disease called "pitting and corrosion" attacks them, they wear out in spots, and holes are formed long before the tube, as a whole, has become too thin for service. Such tubes may be sent to the tube doctor and the hole patched up, but the disease is not eradicated and other holes soon occur, and shortly the whole tube has to be thrown away.

A great deal of research has been expended upon trying to discover the real cause of corrosion and its remedy. Various different kinds of alloys have been experimented with, both in the laboratory and in actual practice, but as a good tube should last at least five or six years in land plants, and considerably longer in ocean going vessels, the practical determination of the best methods takes a long time.

All the authorities are agreed that the alloy known as "Admiralty mixture" is the best that we know of at the present time. It is composed of 70 parts of copper, 29 parts of zinc, and 1 part of tin. Having made up their minds that this was the best mixture to use, the research committees and users of condenser tubes adopted it as the best solution, but the users of tubes found it was not settled at all, for of two lots of tubes, both Admiralty mixture, one would last for years and the other for only as many months.

The committee on Steam Turbines of the Association of Edison Illuminating Companies finally came to the conclusion that the difference between a good tube and a bad one lay in the manner in which it had been treated in the mill, and that in order to get the best results the tubes should be given a careful annealing at a certain temperature and it appears to be as necessary to give these tubes the right temper as it is to temper steel according to the use to which it will be put.

In our own practice we have had a perfect illustration of the difference that there may be between tubes of apparently the same kind. At Long Beach steam plant we have three turbines, each with its own condenser.

The tubes in Number One turbine, now over four years old, are aging gracefully, thinning down it is true, but doing so uniformly, and will no doubt last one or two years more.

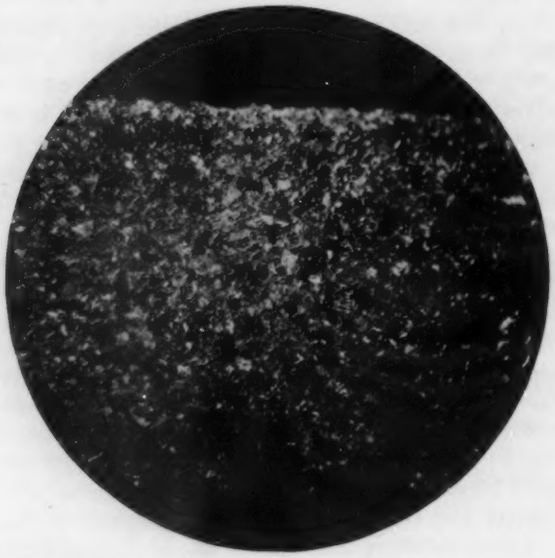
The tubes in Number Three condenser have pitted terribly and they are only eighteen months old. The reason is that the tubes in Number Three condenser were not properly annealed, the evidence being that they were over-annealed. Just as a good machinist or tool maker can tell a great deal about the quality of his steel by noting the size of the crystalline grain when the metal is broken, so it is possible to determine whether brass tubes have been properly annealed by noting whether the grain is fine or coarse.

To bring out the grain in brass and other soft metals, the metal is polished, emery paper of increasing fineness being first used, and then polishing powders, finishing up with jeweler's rouge. The polished surface must be so perfect that even under a microscope it will be impossible to detect any scratches; it is then etched with a suitable acid or reagent when the crystalline structure becomes apparent. The most

durable tubes have a fine grain similar to that shown in the cut which was made from a tube out of Number One condenser at Long Beach steam plant.

The illustration of a coarse grained tube is made from one out of Number Three condenser and shows the great difference between the two tubes.

The cut of an overheated tube shows the result of heating a fine grained tube red hot and quenching.



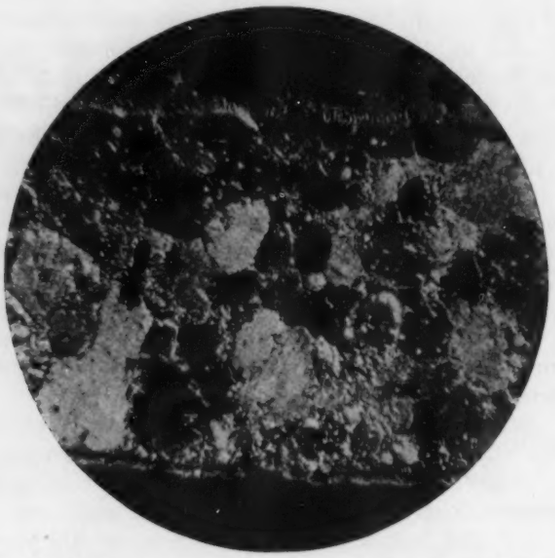
Section of Tube taken from No. 1 Condenser showing Fine Crystalline Structure.

The light and dark crystals as shown in these photomicrographs are not of different composition; it might be thought that the dark areas had more copper in them and the light ones more zinc. This is not so, the difference in appearance of the crystals being due

Section showing Crystalline Structure of a Tube taken from No. 3 Condenser.

to the fact that they reflect the light in different directions. If instead of throwing the light on to the specimen from one side it is reversed and directed from the other side, the light and dark areas change places, what was light before is now dark. This clearly shows that it is not a difference of composition that causes one crystal to look light and another dark.

These three photomicrographs are all magnified fifty diameters and were made by the writer after much tribulation, as the work was new to him. It may be of interest to those readers who are photo fiends, and we nearly all are to some extent, to describe how these photomicrographs are made.



Section of Tube of Originally Fine Structure showing Effect of Overheating and Quenching.

A microscope and an ordinary view camera are required, but no lens is needed with the latter as the microscope lenses take its place. The microscope is inclined so that its tube is horizontal and points into the camera where the lens usually is; the whole arrangement of microscope and camera goes very nicely upon a good solid dining room table; between meals. The space around the miscroscope tube should be filled in with an extemporized front board to keep out extraneous light. The light from a 40 or 60-watt tungsten lamp with frosted globe must be concentrated on the section of brass tube by means of a bullseye lens. With such an arrangement using a Seed Ortho L plate, the exposure required will be of about two minutes.

To revert to tube corrosion, it appears from our experience that corrosion starts in between the crystals, and that when a crystal has been corroded all around it becomes loose in its socket, so to speak, and gets washed away by the water. The larger the crystals and the less uniform in size they are, the quicker we might expect the tube to wear out, and the more likely it should be to break down in spots and make holes. Again the larger the crystals that fall out the rougher the inside of the tube becomes, and the water has a greater hold upon it and wears it more rapidly.

There is another possible cause of tube corrosion about which there is a great diversity of opinion.

It is claimed by some that small particles of cast iron become detached from the piping in the plant through which the water is taken and these particles settle in the tubes and make a little galvanic couple

together with the brass, and that the brass gets eaten up in this way. The proponents of this theory base it chiefly upon the fact that in many cases the pitting of tubes is nearly all along the bottom of the tube.

The opponents, however, state that they have purposely put such particles into condenser tubes and found that they corroded less with the particles in them than they did before. The answer apparently is that there are particles—and particles.

Another cause for corrosion is electrolysis, where return currents from street railroad systems elect to go home by way of the condenser tubes. This form of trouble has been partly neutralized by connecting up a low voltage dynamo to the condenser in such a way tas to oppose the stray currents.

This arrangement has also been proposed as a cure for all tube corrosion troubles and a certain case came to our attention where most remarkable results attended the installation of one of these systems; in fact, since it has been started not a tube had been lost. Success seemed assured. Shortly afterwards it was discovered that the low voltage machine had all the time been connected up backwards, and was helping the stray currents instead of neutralizing them. Evidently a case of faith cure.

ANNUAL REPORT OF THE BUREAU OF STANDARDS.

The annual report of the Director of the Bureau of Standards, Department of Commerce, gives an interesting account of the activities of that Bureau during the fiscal year 1915. The standards with which the Bureau has to deal are standards of measurement, standard values of constants, standards of quality, standards of mechanical performance and standards of practice. The relation of the Bureau's work to the public is clearly discussed, especially the Bureau's part in aiding industrial progress. During the year, 154,000 tests were made and 1,800,000 lamps inspected at the factories.

Color standards, the development of energy-measuring instruments sensitive enough to measure the heat of the stars, studies of the causes of failure of railway materials, exact determination of the data required in the refrigeration industries, and other important researches have made excellent progress during the year.

Of special public interest were the tests of railroad track scales, tests of parcel post scales, the work in methods of precision temperature measurements, with special reference to the refrigeration industries and the measurement of high temperatures and fire resisting properties of building materials.

Of particular interest to manufacturers and testing laboratories are the Bureau's investigations of industrial materials, such as metals, clay products, glass, cement, textiles, papers, rubber and paints. The Bureau issued 47 new publications during the year.

Of special interest to the people is the work of the Bureau in connection with public utilities, particularly in establishing definite standards of service, preparing safety rules, assisting in local studies as to service, acting as referee in cases of dispute and serving as a clearing house of information on all public utility and associated engineering questions, helping to secure uniform methods of accounting where public service commissions are not yet established, and getting out laboratory tests and investigations to answer difficult answers connected with the telephone, gas, electric light and power, electric railway transportation, and miscellaneous utilities other than steam railways.

ELECTROLYSIS MITIGATION.

Among the more important conclusions brought out in Technologic Paper No. 52 of the U. S. Bureau of Standards are the following:

By far the greater portion of the damage due to electrolysis is that arising from corrosion of underground pipes and cables. Electrolytic damage to concrete structures is to be feared only where voltage conditions are exceptionally severe, or in the case of comparatively low voltages when salt has been added to the concrete either during or after construction.

In general, those remedial measures that are applicable to pipe systems should be regarded as secondary means of mitigation of electrolysis trouble, the principal reliance being proper construction and maintenance of the railway return circuit. In special cases, however, mitigative measures may be applied only to the underground structures.

Of the mitigative measures applicable to pipes only a few of those that have been advocated have found much application. The two most commonly applied are the installation of insulating joints and the use of pipe drainage. In most cases these systems should be restricted to use as auxiliary means of protection, after reasonable precautions have been taken to reduce potential drops in the tracks to as low values as are economically practicable. In any case where pipe drainage is used, the drainage should be through the medium of insulated feeder systems, so adjusted as to take the minimum possible current from the pipes at all points.

Of the methods applicable to railways the most important of those which have been thoroughly tried out are the adequate maintenance of track bonding, the use of a proper number and location of power houses or substations, and, where the carrying capacity of the rails is not sufficient to return current to stations without excessive drop, the use of insulated negative feeders for the return of such current, these latter being much more economical than uninsulated feeders where large reductions of potential drop are required. The three-wire system has proved effective in relieving electrolysis and should prove satisfactory from the electrolysis standpoint where operating conditions are favorable to its use.

Such remedial measures as have been adopted in this country have usually been applied to the pipes, and in general they have proven much less effective than measures used in certain foreign countries where regulations limiting voltage drops in the negative return have long been in effect and have been accompanied by substantial freedom from electrolysis troubles. Experience both here and abroad indicates that such limitation of voltage drop is necessary to a satisfactory solution of the problem.

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Valuation Fundamentals

Since most authorities are now agreed that public utility rates should be predicated upon the value of the property used and useful in furnishing the service, the first problem of rate making is evaluation. So many conflicting ideas exist regarding the proper methods of evaluating public utility properties and so many bitter controversies have arisen on this subject that it seems high time to revert to fundamentals. What is value?

Strange, indeed, does it seem that after all these centuries of civilization no one has been able to propound a satisfactory definition of this five lettered word. Mathematically speaking, it is a simple ratio between the article valued and money. But there are so many factors which enter into a determination of this ratio that it becomes exceedingly complex.

Yet there are a few basic principles which tend to clear this much-befogged issue and by keeping them in mind it is possible to steer a straight course. Disregarding all other purposes of valuation except for rate-making purposes, the value of a public utility plant depends upon the point of vision. Two points of view have been given much prominence of late.

One, known as the agency theory, considers a public utility company as the agent of its principal, the public. It regards an electric light and power company, for example, as "springing full-panoplied from the brow of Jove" as did Minerva, an organism which contravenes all recognized processes of growth. Under this theory, valuation for rate-making is ordinarily determined from past costs of building the physical plant.

The other, known as the competitive theory, assumes a gradual, natural growth against contending circumstances, a development such as characterizes any normal animal or plant. From this view-point, value is based upon the cost of reproducing a similar organization under present conditions.

The proponents of neither of these two distinct theories claim that the mere cost, whether the original cost or the cost of reproduction, represents the entire value of the property. There are other elements, the so-called intangibles, which also enter into the equation. Both sides recognize that an inventory of physical equipment does not constitute the value of an established utility, any more than does the physical appearance of a man represent his true worth. The two theories, however, vary widely in their estimate as to the value of the intangibles, and it is upon this rock of contention that many experts disagree.

Without entering into an extended discussion of the merits of these two theories, common sense would suggest that the greatest weight be given to that which most nearly corresponds with the actual conditions under which the plant was built. Most companies have been established under the stress of competition, and so should be entitled to a valuation based upon such competitive conditions.

It is possible that time will change this, that in the future the public utility will act solely as the agent of the public it serves. But even in this case, the theory of agency should not be made retroactive.

Such, at least, is the view of engineers who have built plants. While it does not harmonize with the opinions of many lawyers and political economists, it must be remembered that a legal decision can always be found to bolster up any argument, as court decisions change with the times, whereas engineers deal with conditions which have existed since the beginning of time. Surely the engineer, a man who spends hours on the details of an electric light and power system, is better qualified to pass on its value, than a lawyer or a political economist who spends minutes on the subject and who knows nothing of practical operating difficulties.

Engineering Advice for Army and Navy

When Secretary Daniels announced that the Naval Consulting Board is to be augmented by the appointment, as assistant members, of a representative for each state in the Union from the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers and the American Chemical Society, he pointed out that these five engineering organizations represent a membership of 36,000 men, "particularly fitted to perform this class of work in an intelligent and disinterested manner." This public recognition of the value of the engineer is gratifying and forms the incentive to be of even greater service. Whether the nation-wide compilation of data proposed presages preparedness for peace or preparedness for possible war it is manifestly in accordance with the first principles of national efficiency.

The immediate purpose in gathering together all this information about the country's producing and manufacturing resources is to furnish records upon which to formulate plans for defense. While the compilation of these data may seem an irksome task, they are an essential preliminary to any efficient action. Undoubtedly many engineers will be called upon to help in this work. Let them therefore be found ready and willing to give their assistance.

The great majority of engineers are graduates of universities where military training is required. Many of them have been commanding officers and are thoroughly acquainted with the details of military organization. Such military knowledge, combined with their engineering training, admirably fits them for positions in the army.

Instead of increasing the facilities of the military academies, whose every graduate costs the government twenty thousand dollars, the machinery of existing state universities might well be utilized. Additional stress would be necessary on the military side, a stricter discipline would have to be enforced, and a more democratic standard of living set. This, incidentally, would greatly improve the product of many of our colleges, where snobbishness in inculcated and encouraged by false standards. The plain life of the barracks, the strict supervision and the enforced restraint are sadly lacking in American universities as a whole. From the technical standpoint, however, these graduates, after proper practical experience, are eminently qualified to advise with the army officers.

Modern warfare is essentially an engineering problem. Formerly both army and the navy men arrogated to themselves sole knowledge in these matters. Recently, however, they have shown a desire to call consulting engineers into their councils. Even in such highly specialized branches as constitute the national defense the advice of experienced engineers in others lines of work is most valuable.

Individuality In Lighting

The individuality of the store has long been recognized as an asset. Pirates have frequently tried to copy the individuality of those stores having successful management and pronounced public patronage, thus proving that such individuality is of value. One of the strongest factors in a store's individuality is lighting. Lack of individuality in store lighting constitutes a rebuke to the lighting expert, engineer and fixture dealer, though criticism should be tempered because of the callousness of commercialism.

If fixture manufacturers were a unit actively participating in nation-wide educational movements and had also fostered from the first an appreciation of that which is artistically correct, individuality in lighting would now be practiced as a desirable art and the fixture business for both manufacturer and dealer be on a better or more profitable plane than it is at present. It is true that when commercial or any other form of lighting runs excessively to type, the revulsion causes an appreciation of individuality with the result that the typical installation is thrown into the discard and new and more suitable equipment installed. Herein lies the aesthetician's opportunity.

But to have electric lighting properly appreciated all unwise expenditures on the part of customers must be prevented and difficult though at times this may be, he must be taught to appreciate individuality in lighting and to make expenditures proportionate to its added value and permanence. Properly presented, its influence must be felt by the prospective purchaser just as the actual installation will be later by his patrons.

And all this is especially true, if the lighting (fixtures and methods), rounds out as it is supposed to do, the ornamental and decorative features of interior furnishings.

The day of big blue beads, strings of teeth and feathers as ornaments has passed, as has also the monotony of a single type. Welcome the lighting aesthetician who will introduce into his craft the utmost individuality.

PERSONALS

F. Van Vleck, formerly with the Bristol Company, has returned to Los Angeles.

C. R. Downs, general manager of the Amador Light & Power Company of Sutter Creek, Cal., is at San Francisco.

A. M. Irwin, assistant to the treasurer of the Westinghouse Electric & Manufacturing Company, is visiting Arizona.

Bert Hansen, formerly with the A. G. Electric Company, has joined the sales force of the H. B. Squires Company at San Francisco.

Paul Lebenbaum, electrical engineer for the Portland, Eugene & Eastern Railway Company of Portland, was at San Francisco this week.

R. H. Thomson, former city engineer of Seattle has been engaged by the city of Aberdeen, as consulting engineer of the Wishkah water project.

M. M. O'Shaughnessy, city engineer for San Francisco, is at Washington, D. C., to oppose the granting of a power permit to the Yosemite Power Company.

M. L. Scobey, formerly salesman with the Pacific States Electric Company, now has charge of the General Electric Construction Company at San Francisco.

P. M. Downing is inspecting the tunnel work of the Pacific Gas & Electric Company at Clipper, Gap, Cal. He reports 11 ft. of snow at Drum Power House.

Harry L. Vorse, assistant electrical inspector of the Underwriters' Equitable Rating Bureau at Portland, is confined to his home with a severe attack of grippe.

Frank M. Greenwood, for years prominently identified with the electrical industry in California, has become president of the Gas & Electric Appliance Company of San Francisco.

Geo. F. Fuller has resigned as U. S. inspector of boilers at Portland, after 17 years of service. He will be succeeded by **John E. Wynn,** assistant inspector of boilers at San Francisco.

E. O. Sessions, of the General Devices & Fittings Company, has returned to Chicago, after a visit to the Pacific Coast. He expects to again be in Portland soon after the first of February.

Walter M. Berry has resigned as chemist and superintendent of plant for the Portland Gas & Coke Company to become assistant gas engineer with the U. S. Bureau of Standards at Washington, D. C.

Edwin T. McMurray has been elected president of the Petaluma & Santa Rosa Railway and **E. H. Maggard** general manager to succeed the late E. M. Van Frank, who was president and general manager.

Saburo Oshida, electrical engineer of the Department of Communications of the Imperial Japanese Government of Tokio, is making a study of the electrical industry in the United States, now being at San Francisco.

F. H. Woodward, Oakland manager of the Great Western Power Company, and **Romaine W. Myers,** electrical engineer, are members of the committee on electrical display for the "ad-masque" to be held February 14th at Oakland, Cal.

Lloyd N. Robinson, formerly a member of the field staff of the joint committee on inductive interference of the California Railroad Commission, and recently in the engineering department of the Pacific Light & Power Company of Los Angeles, has been appointed instructor in electrical engineering at the University of California.

Frank J. Gleiss, testing and general efficiency engineer with the Pacific Gas & Electric Company, San Francisco; **Septimas Parker,** operator with the Pacific Gas & Electric Company, San Francisco; **Henry C. Stanley,** engineering department General Electric Company, San Francisco, and **Albert P. Strout,** operator with the Northern California Power Company, Manton, Cal., have been elected associate members of the American Institute of Electrical Engineers.

OBITUARY.

John H. Carr, manager of the Valley Electric Company of Fresno, California, passed away at Fresno on January 11, 1915.

MEETING NOTICES.

Los Angeles Jovian Electric League.

With H. H. Harrison, proprietor of the Commercial Electric Garage as chairman of the day, the league lunch on January 12th was a great success. Aside from some unusual vaudeville entertainment he introduced two headline speakers. Sylvester L. Weaver, president of the Rotary Club of Los Angeles, told "What Rotary means to the Average Business Man," and Willis H. Booth, of Hot Point fame, and also vice-president of the Security Trust & Savings Bank, gave a masterly address on "Trade Conditions of the United States."

Oregon Society of Engineers.

The regular monthly meeting of the Oregon Society of Engineers was held in the Public Library Building, Portland, at 8 p. m., January 13th. The speaker of the evening was Mr. Charles Evan Fowler, M. Am. Soc. C. E., of Seattle, Wash. He illustrated his talk on "The Architecture of Notable Bridges," by about 200 lantern slides. An amendment to the constitution was proposed to be voted upon at the regular annual meeting, February 7th, to provide a students membership to the society with an annual dues of $1 per member.

San Francisco Development and Jovian League.

E. M. Cutting, president of the league, set a fast pace in introducing Fred H. Leggett as chairman of the day for the league lunch on January 12. Mr. Leggett had provided a "dago band," which dispensed some rollicking music before the introduction of Frank I. Turner, president of the Downtown Association and of the Exposition Preservation League, as speaker of the day. Mr. Turner told of the various plans which had been made for preserving the Palace of Fine Arts, the Hawaiian Building, the California Building, and the Oregon Building, as well as the system of boulevards. Geo. C. Holberton also told of the plans for a recreation park for the use of the Pacific Service Section of the N. E. L. A.

Portland Sections A. I. E. E. and N. E. L. A.

The regular meeting of the Portland sections of the A. I. E. E. and N. E. L. A. was held January 11th, at 8 p. m., in the assembly hall of the Electric Building. The meeting was held under the auspices of the local section of the A. I. E. E. with Mr. Paul Lebenbaum as chairman. The subject of the meeting was "Inductive Interference," between power circuits and telephone lines. The paper of the evening was presented by Mr. R. W. Mastick of the Pacific Telephone & Telegraph Company of San Francisco. This was followed by a short talk by A. H. Griswold, plant engineer of the Pacific Telephone & Telegraph Company of San Francisco. An exceedingly spirited discussion followed, which was entered into by Messrs. J. E. Martin, Pacific Power & Light Company, Portland, Oregon; J. B. Fisken, Washington Water Power Company, Spokane, Wash.; F. D. Nims, Olympic Power Company, Port Angeles, Wash.; V. H. Greiser, Washington Water Power Company, Spokane, Wash. After adjournment the members present were served "hot dogs" cooked on an electric range. Attendance 78.

TRADE NOTES.

The Crossett-Western Lumber Company of Wauna, Ore., H. S. Mitchell, manager, has contracted with Hunt, Mirk & Company for the installation of an 1875 k.v.a. Westinghouse high pressure turbine with LeBlanc condenser and 2000 h.p. in motors for the electric operation of the mill.

The Underwriters' Laboratories, Inc., are now examining material and devices as regards their value as "safety first" devices. The first cards are now being sent out on same to the various subscribers to the card index system. The classification is as follows: Anti-slip material, treads, metal working, guarding appliances, wood working, locking devices, elevator, machinery, scaffolding, wearing apparel, goggles.

NEW "EXIDE" DEPOT AT LOS ANGELES.

Kay & Burbank Company, distributors for the "Exide" Starting and Lighting Battery, in Southern Califronia, who for years have been operating an electric garage in Pasadena, have been distributing "Exide" products from that place, have found it necessary for the convenience of their customers, and also owing to the increase in their business, to open up an "Exide" battery depot and service station at Eleventh and Figueroa streets, in the heart of the automobile district of Los Angeles.

The front part of the building is occupied by the office, and a large, well-kept battery stock room, where is carried one of the largest stocks of batteries and parts, on the Coast. In the rear of the building, with entrance on Eleventh street, is housed the battery service department, and the electrical department, where electric vehicle, ignition, starting, lighting and magneto work is taken care of.

NEW CATALOGUES.

The Western Electric 1916 Electrical Supply Year Book is a comprehensive catalogue of over 1500 pages, 7x9½ in., including all standard electrical apparatus and supplies. It follows the admirable precedent of a uniform list price and discount plan which was introduced as an innovation last year.

Catalog No. 4, of the Electric, Railway & Manufacturers' Supply Company of San Francisco, completely lists Westinghouse electrical apparatus carried in Pacific Coast stock. The book contains 221 pages, 6½x10 in., and includes valuable suggestions to dealers regarding methods of selling electric household appliances.

CALIFORNIA PUBLIC UTILITIES ACT IS UPHELD.

Two decisions upholding orders of the Railroad Commission of California have been filed by the Supreme Court of California. They concerned the Marin Water & Power Company and the California Development Company. In the Marin Water & Power Company case the Supreme Court passed upon the validity of the provisions of the Public Utilities Act, empowering the Railroad Commission to fix the value of public utility property in eminent domain proceedings. This provision permits any city or water district or other municipal corporations to ask the commission to fix the value of the property of any public utility which it desires to purchase.

The Marin Municipal water district asked the Railroad Commission to fix the just compensation to be paid to the Marin Water & Power Company for the latter's property. The commission fixed the value at $1,200,000. The company appealed to the Supreme Court to overthrow the commission's decision, claiming that the commission had no authority to fix the value, and, further, that the value fixed was too low, and thus deprived them of their property without due process of law. The company also claimed that the commission should have made a separate finding of value for each item of the property, instead of an aggregate value for the entire property. The decision of the Supreme Court, which upholds the commission's order, opens the way for the district to proceed to acquire the properties of the Marin Water & Power Company at the price fixed by the Railroad Commission.

PUBLICATIONS RECEIVED.

Reports of the Board of Engineers Flood Control to the Board of Supervisors, Los Angeles County, Cal., recommending conservation of storm water through reforestation and retarding work in the mountains, spreading of storm-waters in the gravel deposits at the mouths of canyons, acquisition of official channels for the principal streams, and diversion of the Los Angeles and San Gabriel rivers to Alamitos Bay. Copies may be obtained from J. W. Reagan, Chief Engineer of Flood Control, Hall of Records, Los Angeles.

Water Power Projects, Telephone, Telegraph, Power Transmission Lines on the National Forests. Regulations of the Secretary of Agriculture and instructions regarding applications for permits for water power projects under the Act of February 15, 1901, and for easements for telephone, telegraph and power transmission lines under the Act of March 4, 1911.

Technologic Paper No. 52, U. S Bureau of Standards. "Electrolysis and Its Mitigation." By E. B. Rosa and Burton McCollum.

BOOKS RECEIVED.

The Principles of Dynamo Electric Machinery. By Benjamin F. Bailey, 314 pp., 6x9 in. Published by McGraw-Hill Book Company, New York City, and for sale by Technical Book Shop, San Francisco. Price $3.00.

Considering the large number of text books on this subject the first question which arises is why another. The answer is found in the manner of presentation. The physical phenomena which take place in electrical machinery are clearly described, the mathematical demonstrations being subordinated. As the result of his experience as professor of electrical engineering at the University of Michigan, the author shows what the machine will do and why it does it. Direct current motors and dynamos, together with systems of distribution, characteristics, rating, efficiencies, losses, measuring instruments and accessory apparatus are first discussed. Then alternating currents are simply explained, inductance and capacity effects made clear and measuring instruments illustrated. Finally the transformer, synchronous machine, rotary converter, induction motor, and single-phase commutator motor are each discussed in detail as to theory and operation. This is an excellent introductory text for any college student of electrical engineering.

"Industrial Uses of Fuel Oil," by F. B. Dunn; 235 pp.; 5½ x 8½ in.; 110 illustrations. Published and for sale by Technical Book Shop, San Francisco. Price $3.00.

This text constitutes a practical guide concerning the possible use of fuel oil in any sort of an industrial plant. It differs from the usual published information in that it not only discusses the properties of oil, its storage, furnace arrangement and methods of burning, but also gives practical suggestions for its application in various manufacturing plants—clay, lime and cement, glass, locomotive, sugar, rubber, smelting, shops, steel, maritime and domestic purposes. Special attention is given to the rotary system of burning oil and there is an extended treatment of furnace efficiency and combustion. The chapter on tests and reports is particularly complete. A final chapter is concerned with oil for gas making. This is an excellent work for any steam engineer, architect, plant superintendent, manager or fuel oil salesman, as it brings into compact form all that is essential in determining the possibility of using oil as a solution of the fuel problem. It is written in a practical manner for the use of practical men.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—E. H. Electric Company, San Francisco, $20,000; shares $5 each, subscribed, $15, by J. A. Hunt, F. I. Ellert and W. M. Brownlie.

SAN FRANCISCO, CAL.—The Pacific Gas Appliance Company, San Francisco, $75,000; shares $100 each, subscribed $4500, by M. J. Purcell, S. F. Chase and Eliza A. Nordman.

ILLUMINATION.

BERKELEY, CAL.—The city council has set January 25th as the date for calling bids for the new lighting system.

HUGHSON, CAL.—Construction of a street lighting system is proposed by the board of trade. L. C. Quimby is interested.

COULEE CITY, WASH.—The merchants of Coulee City are organizing a stock company to put in water works and electric lights.

OREGON CITY, ORE.—Mayor Hackett is in favor of a municipally owned light and power plant utilizing the city right to power from Willamette Falls.

REDDING, CAL.—City Electrician E. Rolison has been authorized by the trustees to make the first purchase of materials for the new street lighting system in the sum of $1100.

AZUSA, CAL.—The board of trustees has awarded the contract for the installation of a lighting system on portions of Pasadena avenue, Sunset avenue and certain other avenues, to the F. O. Engstrum Company at $7140.

LOS BANOS, CAL.—Application has been filed requesting the board of trustees to grant a franchise to construct a gas plant and lay pipes to convey gas to dwellings. Sealed bids will be received for said franchise up to February 19th.

TUCSON, ARIZ.—Plans for the construction of new water and electric plants for the city will be submitted by Sidney F. Mashbir, and it is anticipated that work will be started within sixty or ninety days. The lighting will consist of two units.

PASADENA, CAL.—The city commission has awarded the contract for street lights on Colorado and certain other streets, to the F. E. Newberry Electric Company at $3728, and the contract for lights on Raymond avenue to the Southern California Edison Company, at $2386.

TRANSMISSION.

GLOBE, ARIZ.—The Arizona Commercial Mine Company is preparing to erect a $50,000 power plant.

HOOD RIVER, ORE.—A Guignard et al are considering construction of a dam and hydroelectric plant to cost $40,000.

BELLEVUE, IDAHO.—I. E. Rockwell, manager of the Rockwell-White Power Company of this city, has taken over the Bailey Electric Company.

OAKLAND, CAL.—The Great Western Power Company will construct a line from Fourth avenue sub-station to Yerba Buena station of the Key System. The estimated cost is $100,000.

PORTLAND, ORE.—A franchise granting power and water privileges to the Oswego Lake Water, Light & Power Company has been approved by the board of county commissioners. The grant is for 25 years.

SPOKANE, WASH.—A hearing will be held by the commissioners of Spokane County on January 28th, on the application of the Valleyford Water Company for permission to construct electric transmission lines in the town of Valleyford.

TWIN FALLS, IDAHO.—All the property and holdings of the Great Shoshone & Twin Falls Waterpower Company have been sold at public auction for $2,000,000 to F. F. Johnson of Boise, acting for the Electric Investment Company, with headquarters at Boise.

YREKA, CAL.—A. L. Harlow has completed arrangements for the purchase of the holdings of the Mount Shasta Land & Irrigation Company in the Big Springs section of the county. Mr. Harlow expects to install a new power plant and construct new ditches.

BOISE, IDAHO.—The state land board has directed State Engineer Smith to make an examination of the physical features regarding the completion of the works on the Twin Falls-Salmon River project so that the board may have the report when passing definitely on the application of G. M. Hall, manager for the project and O. O. Haga to have the work approved officially.

SALEM, ORE.—Permits for development of 952 horsepower from the John Day River and Warm Springs near Prairie City have been granted by State Engineer Lewis, to the Prairie Power Company. The company proposes to extend a canal near Prairie City about two miles, construct a reservoir at Strawberry Lake and develop power for lighting Prairie City, Canyon City and John Day. A large mining dredge will also be operated on Canyon Creek. The estimated cost of the project is $45,000. A permit also has been granted to Horace G. Campbell of West Lake, Ore., to develop power at the outlet of Whoahink Lake in Lane county,

TRANSPORTATION.

UPLANDS, CAL.—Permission has been granted to the Pacific Electric Railway Company to construct a spur of track over and across Huntington Drive, near Orange Grove avenue.

RENO, NEV.—Reports come from Fallon, which are assuring that an electric road may be built there in the near future. R. W. Riley of Portland, has spent a couple of weeks looking over the project.

SAN DIEGO, CAL.—The street railway line to La Playa, the franchise for which was issued more than a year ago, will be built soon. It will connect with the Point Loma line where the latter turns off at Roseville.

PHOENIX, ARIZ.—It has been decided that the Phoenix Street Railway Company shall be given until October 1, 1917, to complete the work of double tracking its West Washington Street line. The tracks will also be doubled between Seventh and Seventeenth avenues.

LOS ANGELES, CAL.—The city council has adopted an ordinance consenting to the abandonment of a certain portion of a franchise heretofore granted to the Pacific Electric Railway Company to construct, and for a period of forty years to maintain a double track, or a four track elevated electric railroad, across certain public streets in this city.

SPOKANE, WASH.—Plans for a holding company to take over and operate both local street railway lines are nearing completion, according to reports from authentic sources. Such an arrangement, it is believed, will do much toward solving the financial loss confronting the Washington Water Power Company and the Spokane Traction Company in the operation of their street railways. Recently, before the city council, D. L. Huntington, president of the Washington Water Power Company, stated that the company's street railway business was being conducted at a loss and he expressed the opinion that the same was true of the operation of the Spokane Traction Company. Two factors have been making serious inroads into the business of the street railway companies. One is the increasing number of privately owned automobiles whose owners formerly patronized the street cars. Another is the jitney bus.